ENGINEERING NEWS.

Tribune Building, New York City.

GEO. H. FROST, PROPRIETOR.

SATURDAY, MARCH 5, 1881.

THE River and Harbor Bill, appropriating $11,330,000, has been approved by the President.

THE Buffalo Common Council has lately set itself up as an Examining Board of Engineers, and a critic of approved engineering plans. The engineer of the city was commissioned to have specifications for a belt sewer, and after consultation with Mr. Adams, of Brooklyn, and Mr. Lane, of Milwaukee (and formerly of the Boston Waterworks), he drew up a set of plans. The Common Council have picked this to pieces, and threaten to make further amendments.

WE commence to-day the publication of the "History and Statistics of American Water-Works," by J. James R. Croes, Member A. S. C. E., as heretofore announced, and we will print two pages per week till the whole is completed. We earnestly solicit reports and all other information relating to water-works from water-works officials; suggestions and criticism will also be acceptable, as it is our desire to make this history as complete and valuable as possible.

WE have received from J. E. Sherman, Secty., the report of the second annual meeting of the surveyors and civil engineers of Michigan. It is an octavo pamphlet of forty pages, and, besides, the Proceedings of the meeting, it gives in full a valuable paper, by Justice Cooley, of the Michigan Supreme Court, on "The Judicial Functions of Surveyors;" an illustrated paper, by Prof. Chas. E. Greene, on "A Modern Trestle Bridge over the Huron River at Ann Arbor;" a paper by H. D. Bartholomew, C. E., on "The Surveyor in Perspective," and one by F. Hodgman, County Surveyor of Kalamazoo Co., "About Corners." This pamphlet is a very valuable one for surveyors, and it can be had by sending ten cents to J. E. Sherman, C. E., Lansing, Mich. We will, as rapidly as space will allow, publish this report, but we advise the purchase of the whole in its present form as well.

THE HUDSON RIVER TUNNEL.

Several changes designed to facilitate important branches of the work at the tunnel have been made since our last visit, and have resulted in an increase of the average daily amount of completed tunnel, with an expenditure of less labor and time.

The south tunnel has been finished for about three hundred feet from the caisson, and has been left about one-half full of the excavated silt, which will not be removed until the land approach shall have been opened; then it can be taken out at a much less expense than at present. Extending along the south side of the tunnel is a narrow-gauge track, upon which runs a dumping-car holding about one and one-half cubic yards. The silt taken from the heading is placed in the car, which is drawn up by a small steam engine placed near the west wall of the caisson. Where the track reaches the top is a sharp incline, of about forty-five degrees, whose rails are placed just wide enough apart to permit the front wheels of the car to pass between and remain on an horizontal track; the rear wheels, having faces two or three inches wider than those in front, ascend the incline, and the bottom of the car slopes sufficiently to permit its load to slide off into a well. The silt in the well is mixed with enough water to make it flow easily. Extending from the well to a reservoir on the surface is a large pipe. When the end of this pipe that is in the well is submerged, a valve in the pipe is opened, when the air pressure forces the silt from the well into the reservoir. This reservoir is built at sufficient elevation above the ground to admit a car under it. When loaded this car is drawn back on the meadow and its contents dumped.

When the caisson was constructed, two air-locks were placed in its roof—the larger one being for the men and the smaller for material. The lower end of the small air-lock has been fitted with an extension, which is just a quadrant of a circle: its cross-section is square, while that of the remaining portion is round. One door is placed at the lower end of the lock, the other at the upper and about three feet above the surface of the ground. This lock is at present used only for brick, the cement, plates, etc., being carried in through the old horizontal one. In loading this—the lower door being closed—a barrel is filled with bricks and lowered into the lock by a rope and tackle; when at the bend the bottom is dropped from the barrel and its contents falls out. The load varies from fifty to one hundred barrels of bricks. After the upper door has been closed the lower one is opened and the bricks fall on the platform of the caisson. They are then placed on an ordinary platform car running upon a track extending down the north tide of the tunnel to the heading. This car also carries down the plates, timbers and bags of cement.

At present there are two electric lights, one in the center of the south tunnel at the caisson, and the other at the heading. Although these are of large candle power, that portion of the tunnel between the lights is in comparative darkness, rendering the use of candles necessary. It is now designed to place a row of electric lights along the tunnel at intervals of about seventy-five feet.

At the time of our visit, Feb. 22, the air-pressure was eighteen and three-quarter pounds.

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.*

BY J. JAMES R. CROES, M. AM. SOC. C. E.

INTRODUCTION.

In the following pages will be found historical sketches of the construction and operation of the works for supplying water to the towns in the United States and Canadas, compiled from information furnished by the officers of those works either directly or through their printed reports.

The works of the 21 cities of more than 100,000 inhabitants are first described, in the order of their population, according to the last census, followed by tabular statements of the cost, consumption, operating expenses, revenue, rates and other principal features of value for comparison. Similar descriptions of groups of towns according to their population, with comparative tables, follow. Separate chapters show the comparative condition and efficiency of the various modes of supply and method of operation and management, irrespective of the size of the towns.

Unexecuted projects for supplying towns are, as a rule, not mentioned.

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I.—NEW YORK CITY.

The city of New York occupies a tract about two miles wide and sixteen miles long. Its southern extremity, from the Battery Park to Grand street, is a triangle a mile and a half long, with a base of two miles. Northwardly from Grand street, for seven miles to Harlem, the city lies between the Hudson and East rivers, deep, tidal streams parallel to each other. At Harlem the East River divides into two parts, Long Island Sound turning to the east and the Harlem River flowing diagonally across the city to Spuyten Duyvil, on the Hudson River, thirteen miles from the Battery. Northwardly from the Harlem the city is bounded on the east by the Bronx River, a small fresh water stream, and is three miles wide for eight miles to its northern boundary, an arbitrary line drawn across the country.

Topographically the lower portion slopes each way to the rivers from the main street, Broadway, which runs on the axis of the city, rising from the Battery about 40 ft. in the first mile, and continuing at nearly that elevation for three miles farther.

For comparison of distances, it may be borne in mind that, at two miles from the Battery, the cross streets begin to be designated by numbers, and that there are twenty streets to the mile.

Above Thirtieth street the elevation of the central plateau is from 50 to 80 ft., and from Eightieth street to 125th street it is from 80 to 120 ft. on the west side of the city, the eastern side being lower. Above 130th street, and west of the Harlem River, the ground is from 150 to 200 ft. high. North of the Harlem River the ground is irregular, varying from 10 to 280 ft. elevation.

In 1774, the population being 22,000, and comprised within two miles of the Battery, Christopher Colles, a civil engineer, constructed by order of the Common Council a reservoir on the east side of Broadway, a mile and a half from the Battery, and sunk a large well on the bank of the Collect, a stream near by. The completion of this work was prevented by the breaking out of the War of the Revolution.

In 1799, the population being 60,000, the city subscribed for 2,000 shares of the stock of the Manhattan Company, a corporation organized for supplying water and for banking purposes. This company constructed a well near the Collect, at what is now Centre street, between Reade and Duane streets. This well was 25 ft. in diameter, and 30 ft. deep, and water was pumped from it by two steam engines, each 18 horse-power, to a reservoir on Chambers street. The distribution pipes were bored logs. In 1823, 25 miles of such pipe had been laid, the engines were worked 16 hours per day, and raised 691,200 gallons, being one-fifth more than the capacity of the reservoirs; 2,000 houses were supplied with water, besides several manufactories. The population then was about 150,000.

Between 1830 and 1832 the Manhattan Company sunk a well at the corner of Broadway and Bleecker street, 8 in. in diameter and 442 ft. deep, through rock. The water in this well stood at 29 ft. below the surface, and it yielded 44,000 gallons per day when pumped from with a 6 horse-power engine. In 1830, the Manhattan Company not furnishing a sufficient supply, the city constructed works for the use of the Fire Department, consisting of a well at Thirteenth street near Broadway, 16 ft. in diameter, 112 ft. deep, 97 ft. of which was through rock. At 12 ft. from the bottom two lateral galleries were run out, each 4 by 6 ft. and 75 ft. long; one of these had a branch 25 ft. long. The water rose to within 12 ft. of the surface, which was 50 ft. above high tide. A 12 horse-power engine pumped the water into an iron tank 44 ft. diameter and 20.5 ft. high, the bottom being 83.5 ft. above tide. The engine could run for three hours, twice a week, making the yield average

10,428 gallons per day. Before the lateral galleries were run the water was very soft, afterwards it was exceedingly hard. The cost of the works to December, 1832, was $42,233. A line of 12-in. cast-iron pipes from Thirteenth street down Third avenue and the Bowery to William street, with 10 and 6-in. branches in cross streets, had been laid in connection with this reservoir, in all 34,726 ft., at a cost of $70,950. The insufficiency of the water supply at this time was such that 600 hogsheads of water were daily brought to the city from wells in the adjoining country, and sold at an average price of $1.25. The hotels paid from $200 to $450 per annum for well water, and boarding-houses from $15 to $50. There were, also, 415 hogsheads of water supplied daily from Brooklyn for the shipping, at a cost of $160 per day.

In 1834 a boring 2½ in. in diameter was made in the bottom of the Thirteenth street well to a depth of 100 ft. This increased the supply to 21,000 gallons per day. About the same time a well was dug near Jefferson Market 16 ft. in diameter and 30 ft. deep, from which an 8 horse-power engine with pump 7 in. in diameter forced water to the Thirteenth street reservoir, a distance of a quarter of a mile.

The Common Council up to February, 1835, had laid down for fire service from this reservoir 80,199 ft. of cast-iron mains. The pipes were 9 ft. long over all, with 6-in. joints, making the net length laid 74,880 ft. The cost at the prices then current was:

48,705 feet 12 inch pipe		$100,561.50
18,520 " 10 " "		31,430.40
7,046 " 6 " "		6,882.45
158,478 lbs. lead		7,023.90
12-inch pipe, ditching and laying	$14,438.30	
6 " " " "	4,518.12	
1b " " " "	1,258.60	
		20,214.92
34 12 inch stop-cocks	$3,774.00	
19 10 " " "	1,780.00	
8 6 " " "	488.00	
		6,048.00
176 fire hydrants @ $28.50	$5,016.00	
334 branches	4,629.49	
Fuel used in melting lead	145 00	
		9,790.49
		$182,851.06

On March 11, 1835, a scheme for procuring water from the Croton River, as recommended by Major D. B. Douglas, was adopted by the Common Council, and afterwards ratified by a popular vote of 17,330 to 5,963.

The water shed of the Croton has an area of 338.82 square miles. Its southern limit is 40 miles north of the Battery, its length averages 25 miles, and its width 13.5 miles. The valley of the main stream is 120 ft. above tide water at the point where the supply is taken and rises to 450 ft. at the head waters. The tributary streams rise to from 300 to 600 ft., and the surrounding hills are from 400 to 1000 ft. above tide. The topography is very broken and the surface rocky. The rock is the Laurentian gneiss. A large proportion of the area is wooded. The minimum discharge of the river flowing in its natural state which has been observed was, on August 16, 1838, by Horatio Allen, C. E., and was at the rate of 31,663,878 U. S. gallons in 24 hours; or 0.126 cubic feet per second per square mile.

The maximum noted discharge was in April, 1854, and is estimated at 74.87 cubic feet per second per square mile.

The daily flow of the stream at the Croton dam has been noted. Observations on rainfall were begun in 1864 at the dam, and in 1866 at a point 23 miles above the dam. In the following table the yearly discharge is given as computed by James P. Kirkwood, C. E., from 1864 to 1869, in inches of rainfall on the water shed. From 1870 to 1879 the discharge is given according to the statements published in the annual reports of the Department of Public Works. The mode of computation lately followed gives results about ten per cent. greater than Mr. Kirkwood's.

RAINFALL AND FLOW CROTON RIVER, 338.82 SQ. M.

Year.	Rainfall. Inches in Depth.	Discharge. Depth.	Year.	Rainfall. Inches in Depth.	Discharge. Depth.
1864	40.80	14.80	1873	43.87	27.50
1865	52.43	20.56	1874	42.37	26.33
1866	48.57	25.21	1875	43 66	27.00
1867	50.77	30.65	1876	40.68	22.80
1868	50.33	34.80	1877	46.03	21.47
1869	48.36	25.55	1878	54.14	28.69
1870	44.63	21.56	1879	46.08	21.85
1871	48.94	22.12	1880	38.52	15.08
1872	40.74	19.04			
Averages				45.93	23.829

THE AQUEDUCT.

Major David B. Douglas, as chief engineer, located the route of the aqueduct and prepared the plans.

In October, 1836, John B. Jervis, C. E., became chief engineer, and continued in charge to the completion of the work. Major Douglas's general design was carried out, but with modification of detail.

The Croton aqueduct is a masonry channel, lined with brick. The bottom is an inverted arch of 6.75 ft. chord, and 0.75 ft. versed sine. The side walls are 4 ft. high, battered so that at the top they are 7.42 ft. apart, and surmounted with a semicircular arch. The interior is 8.64 ft. high, and its area is 53.34 square feet. The foundation is of concrete, the side wall and spandril backing of rubble masonry.

The sectional area of the masonry was 42.525 square feet.

On embankments a wall of dry stone rubble was built up from the natural surface to the foundation level. The top of the masonry was 4 ft. under ground. The embankments were 8 ft. wide at the top, with side slopes of 1½ to 1. On high embankments the sides were supported by retaining walls of dry stone below the spring line of the arch.

The dry stone foundations in the embankments settled soon after construction, and before water was introduced. Mr. Jervis stated in December, 1841, that "this settlement had rarely exceeded three or four inches, producing checks or cracks that with few exceptions range within one-eighth of an inch.

On June 27, 1842, water was first passed through the conduit to the receiving reservoir. Every year small cracks were found in the masonry, showing that the work was still gradually settling. The first indication of its having assumed a serious character was in the spring of 1855. A crack, into which a knife blade could be inserted, appeared in the bottom for three hundred feet on an embankment causing a leak which appeared outside.

The next serious break recorded was in December, 1860, when a crack 425 ft. long and from ¼ to 1½ in. wide occurred in another bank. In June, 1861, another fissure occurred 350 ft. in length, producing a serious leak. For a portion of its length this fissure was in the centre of the invert; for the rest of the way it was at the junction of the invert with the side wall. From that time to the present, such leaks have been frequent and increasing in number and magnitude, requiring constant watchfulness and prompt action. Between 1863 and 1869, fissures of an aggregate length of 34,271 ft. were repaired. Except the mere stoppage of the leaks, nothing was done toward permanently repairing the weak places until 1876, when a general plan for strengthening the conduit was adopted, consisting of increasing the thickness of the arch, raising the spandril backing, and lowering and widening the top covering of earth. In prosecuting this work from the exterior, leaks and defects are discovered of which interior examination shows no trace. The defect in the original construction seems to be that the dry stone foundation was not secure against settlement.

The result of this settlement has been that the conduit has split longitudinally at top and bottom, the earth on the sides has washed down among the loose stone, the arch has spread at the spring line and settled at the crown.

The fall of the floor of the aqueduct from the dam is:

	Distances. Miles.	Feet.	
In	4.9490	2.9507	
"	27.9316	30.9700	to Harlem River.
"	0.2750	2.3450	across Harlem River in pipes.
"	2.0140	2.2334	to Manhattan Valley.
"	0.7917	3.7783	across Manhattan Valley.
"	2.1727	1.6295	to Receiving Reservoir.
	43.7069		total.

Total fall of masonry conduit ..... 37.0343 miles.
" " " iron pipes ..... 1.0667 "

The ordinary grade is 0.021 ft. per 100 or 1.1088 ft. per mile.

Two interruptions in the uniform grade of the conduit occur at the crossings of deep valleys. At the Harlem River a bridge was built, which was required by law to give 100 ft. of clear height above high water. To save expense, the commissioners placed the bridge exactly at that height and carried the water across in two 36-in. pipes, which were 11 ft. lower than the grade of the aqueduct. It was supposed that they would be sufficient for fifty years. A difference of level of 2.34 ft. was made between the two sides of the valley, a quarter of a mile.

It was estimated that to have built the bridge higher, and to have carried the aqueduct across at grade would have cost half a million dollars more. The bridge is of granite masonry, with 7 spans of 50 feet, and 8 spans of 80 feet. Its length between gate houses is 1,393.38 feet. In 1860 it became necessary to enlarge the capacity of supply. On the floor of the bridge, between the 36-in. pipes, cast-iron standards were placed 12 ft. apart, longitudinally. Their tops are 2½ ft. square, and planed. Three cast-iron rollers, turned true, rest on the standards; on them rest cast-iron saddles, the base of each being 2½ ft. square and planed.

In the saddles a wrought-iron pipe 7 ft. 6½ in. in diameter rests, formed of plates half an inch thick, 6 ft. long and 8 ft. wide. The joints are planed to the radial lines, abutted and covered by straps on the outside, each strap being 9 in. in width and one-half of an inch in thickness. There are four rows of three-fourth inch rivets in each strap. In the interior the rivets are counter-sunk to the plane of the pipe. At each end of the bridge, and built into the masonry connecting the pipe with the gate house, is a slip joint, the moving surfaces of which are faced with brass. The temperature of the water varying 50° between winter and summer, the length of the pipe varies about six inches. The pipe is kept painted inside and out, and after twenty years of service is in good condition. To protect this work from the weather and at the same time give convenient access to it and make a footway across the bridge, which is the only means of communication between the two sides of the Harlem River for five miles, the side walls of masonry were raised 6 ft. Cast-iron skew-back beams connected across by wrought-iron tie rods were laid on each wall, and a 12-in. brick arch of 16 ft. span and 15 in. versed sine turned between them. The spandrils were leveled up with gravel concrete, which was covered with a half-inch coating of Trinidad asphalt, on which was laid a course of bricks flat, in asphalt. On this was laid a pavement of brick in cement mortar. To allow for expansion three or four grooves two inches wide and 4 inches deep were cut in the top of the arch and filled with paint cement. Although the upper course of brick has been somewhat worn by travel, this roof remains water tight. The chamber in which the pipes are laid is 14 ft. square and is lighted by glass and iron vault lights in the roof. This work was built after the plans of Gen. George S. Greene. The capacity of the pipes is now equal that of the aqueduct.

The depression at Manhattan Valley, 2 miles long, is crossed by two lines of 36-in. iron pipe. In 1853 an additional 48-in. pipe was laid. In 1861 a 60-in. pipe was laid. This was the largest cast-iron water pipe constructed up to that time.

The pipes were straight cylinders. The joints were made by cast-iron half sleeves, with flanged joints bolted together. In 1861 a branch of the aqueduct was built from Ninety-second street to connect with the new reservoir. This portion was all in excavation, and to pass under the grade of streets was depressed below the grade line so that it was always under a head. In 1865 the portion of the aqueduct leading to the old reservoir below Ninety-second street was removed and two lines of 72-in. cast-iron pipe laid through the streets substituted for it. Out of 486 pipes laid 20 cracked soon after the water was let in, the cracks being generally at the hub. A great number of them have broken from year to year since that time and have been repaired by banding them with wrought-iron straps. It is supposed that the pattern of the hubs was too light and that the earth and rock filling on which they were laid continued to settle. Between 1870 and 1875 three-quarters of a mile of masonry aqueduct within the city was removed and replaced by six lines of 48-in. pipes laid in the streets.

DAMS.

The dam across the Croton River at the head of the aqueduct was first built with an overfall of 90 ft. in length of masonry, the remaining part being earth embankment. On January 7, 1841, soon after its completion, a freshet occurred, which the waste way was unable to carry off, and the water rose 15 ft., overflowed the earth embankment and carried it away. When rebuilt an addition of 180 ft. was made to the overfall.

The foundation is two lines of cribs filled with dry stone, the intervening space of 10 ft. being filled with concrete. Broken range masonry was laid on this and the down-stream face laid with fine cut granite. This face is curved. The wall is backed with earth. A secondary low crib dam, with planked apron, forms a basin for a water cushion to receive and break the shock of the water.

In 1866–72, a dam was built for a storage reservoir at Boyds Corners, 23 miles from the Croton dam. This dam was designed by Gen. George S. Greene. It has squared stone faces filled between with concrete. The up-stream face is vertical; the down-stream face batters 4 feet in 10. Its extreme height from the rock foundation is 78 ft., and its length on top 670 ft. Its top width is 8.6 ft. The waste water is carried off by a bye-wash cut in the rock at the end of the dam, 135 ft. long.

Mr. E. H. Tracy, who succeeded Gen. Greene as Chief Engineer in 1870, added an earth embankment on the up-stream side.

In 1874–8 a dam was built for another storage reservoir on the middle branch of the Croton, after designs of Mr. Tracy. It is of earth, with a centre wall of rubble masonry carried to rock bottom. The overflow is through a channel cut in the rock and the water is drawn off through a tunnel driven around the end of the dam in rock. A dam is now under construction for another storage reservoir on the Bronx River at Kensico, after plans of Mr. G. W. Birdsall. Its design is similar to that of the Croton dam.

RESERVOIRS.

The first receiving reservoir, built before 1840, is six miles from the Battery. It is in two divisions, and is rectangular in form, 1826 by 836 ft. and 20 ft. deep; it contains 150,000,000 gallons. The interior slopes are lined with dry stone wall.

In 1858–62 a receiving reservoir was built after Gen. Greene's plans adjoining the old one, with 96 acres of water surface and 36 ft. deep, containing 1,200,000,000 gallons. Its outline is irregular, the position of the embankment being adjusted to the topography. The banks are of earth, 15 ft. wide on top, with slopes of 1½ to 1. In the centre of all the banks there is a puddle wall extending from the rock to 2 ft. above high-water level. Where soft or disintegrated rock was met, a trench was excavated in it to solid material and filled with concrete, built up to form a core for the puddle wall a few feet above its bottom. The inner slope of the embankment is faced with concrete 8 in. thick, on which is laid a paving of large stone 18 in. thick, in cement.

The influent and effluent gate houses are built of granite masonry. The reservoir is in two divisions, either one of which can be used alone. The chamber in the effluent gate house, in which the gates are placed, is separated from the pipe vault by a wall 6 ft. thick of concrete faced with brick. On the admission of water to this chamber it was found that the water passed through this wall. The reservoir was emptied, the walls thoroughly dried and then washed with a solution of castile soap and alum. The soap solution was laid on hot with a white-wash brush, and the alum wash applied afterwards. Four coats were applied, and the chamber has not leaked since.

The distributing reservoir on Murray Hill, four miles from the Battery, is a rectangular structure, holding 24,000,000 gallons, four hundred feet square at the water's surface. The exterior walls of cut stone masonry are double, connected by arches. An earthen embankment is placed against the inner face, on which a stone paving is laid.

In 1866 a reservoir for the supply of the district above the aqueduct level was built at the west end of High Bridge. Its capacity is 10,794,000 gallons; it is 16 ft. deep, and its flow line is 216.6 ft. above tide level. An iron stand-pipe and tank, containing 47,000 gallons, and inclosed in an ornamental masonry tower, the flow line being 324 ft. above tide level, is connected with the reservoir, and both are supplied by engines pumping from the aqueduct. The reservoir banks are of earth, with the inner slopes paved with stone laid in cement.

PIPE DISTRIBUTION.

All water mains are of cast-iron.

The connection between the receiving and distributing reservoirs was first made by two lines of 36-in. pipe. The water commissioners in 1840 reported that by excavating the trench "of a width sufficient for two instead of three lines of large pipe which will furnish a sufficient supply for at least half a century," they had saved $10,000.

In 1849 the Croton Aqueduct Board stated that those mains were insufficient, and a 30-in. main was laid to supply the eastern part of the city.

In 1855 a 30-in. main was laid for the western part of the city, and in 1861 another 48-in. main was laid between the reservoirs.

Changes of grade in some of the avenues obliged the lowering of two lines of 36-in. pipe below the reservoir for 1,400 feet. The water was shut off during this lowering, but in 1861 a long line of pipe on Eighth avenue was lowered 7 ft. through rock cutting without drawing off the water, and in 1870 two lines of 36-in. mains on Fifth avenue were lowered 4 ft. in rock cutting, for a distance of 1,000 ft., without drawing off the water.

Changes of the grade of Fifth avenue raised the surface 13 ft. at a place where wet low land occurred between two ledges of rock. The additional filling on the connecting mains between the reservoirs, caused a number of serious breaks at this point, until in 1868 new pipes were laid over the old ones and at the ordinary depth below the surface for a half mile.

Prior to 1858, cast-iron pipes were laid without any protection except whitewashing on the outside. From 1858 to 1870, all pipes were coated with Dr. Angus Smith's preparation. From 1870 to 1874 the use of this was discontinued and the pipes laid unprotected. Since 1874 the use of this coating has been resumed.

The first distribution pipes were laid by a separate commission from that which built the aqueduct; about 50 miles were laid by them. There are now in use 500 miles of pipe, 5 miles of which are 4 inches in diameter. No 4-in. pipes were laid between 1851 and 1870; 4 miles were laid between 1870 and 1874; none have been laid since that time.

Experiments on the loss of head have been made as follows:

At Canal street and Broadway, four and a half miles from the reservoir, the loss of head was:

	Feet.
July, 1858	52⅛
" 1864	46
" 1878	50.7

The increase of head at this point is due to the additional mains which have been laid from the reservoir.

[TO BE CONTINUED.]

We are pleased to acknowledge the receipt of complete reports of the Lawrence Water Commissioners and Water Board, to present date, from A. D. Marble, Supt.; of Report of the Case of the Watuppa Reservoir Co. *vs.* The City of Fall River, by Wm. Rotch, C. E., late Supt. of Fall River Water-works, from Philip D. Borden, Jr., City Engineer; also Reports to 1879 of Public Water Board, City of Lynn, Mass., from Daniel Walden, Supt. of Water-works; a copy of the Joliet *Sun*, containing description of City Water-works; the 29th Annual Report of the Board of Water Commissioners of the City of Detroit, sent by Henry Starkey, Esq., Secretary; First Annual Report of the Water Commissioners of Pawtucket, R. I., from Edwin Darling, Supt.; The Effect of the Water Privileges of the Watuppa Reservoir Company, due to the use of water from the Watuppa Ponds by the City of Fall River, a Report by Charles E. Emery, Ph.D., Consulting Engineer, N. Y., 1881, sent by P. D. Borden, Jr., City Engineer, Fall River, Mass.

PERSONAL.

A company of engineers, numbering two hundred, will embark for Natal on the 25th inst. from England.

The oldest railroad engineer in the United States is George Lay, of Howard, Md. He is 76 years old and ran the first locomotive on the B. & O. R. R. in 1832. The Brotherhood of Engineers recognize him as their professional dad.

The general offices of the Mexican Central Railway are at 87 Milk Street, Boston. Thomas Nickerson is President, and S. W. Reynolds is Treasurer. The headquarters of the engineering department are in the city of Mexico; Rudolph Fink C. E., being General Manager.

J. J. O'Neil, Division Engineer C., B. & Q. R.R., between Rose Creek Division, Nebraska, is spending a week with his friends in Elizabeth, N. J., of which city he was for five years Assistant City Engineer. Mr. O'Neil had charge of the construction of sewers in the City of Omaha in 1878 and 1879, under City Engineer H. Rohwer.

Ex-Controller W. G. Steinmetz, of Brooklyn, has received the appointment of Associate Engineer of the Dapariment of City Works from Commissioner French. He will have charge of the streets of the city, while Chief Engineer Van Buren will supervise the water-works. The former Assistant Engineer, V. B. Bergen, has been appointed Superintendent of Ponds and Conduits.

We are pleased to note that Mr. D. W. Cunningham, formerly one of the Chief Assistant Engineers in the Boston Additional Water Supply, having returned from the West, where he was engaged in railroad construction, has opened an office at 7 Exchange Place, Boston, Mass., as a Civil and Hydraulic Engineer, and offers his advice and services in the planning or construction of water-works, drainage and sewerage-works, in the construction of which he has had twenty-five years' experience.

The Drainage Construction Company, of 44

State street, Boston, Mass., have issued in a neat pamphlet form, for gratuitous distribution we suppose, a paper on "The Sewerage of Memphis," read by Geo. E. Waring, Jr., Sanitary Engineer, before the Sanitary Institute of Great Britain, Sept. 23, 1880, with a discussion of the same by the Institute. The pamphlet contains 18 pages octavo, and is illustrated with a sewerage map of Memphis showing contours and sewers, and with a plate of details of Field's Flushing Tank as used in Memphis.

Thomas A. Edison has removed from Menlo Park to this city which his family and all but one of his assistants, and is now living at No. 65 Fifth avenue. The house was formerly known as the Bishop mansion, and has been leased for a long term of years by the Edison Electric Light Company. The technical department of the business is now carried on here. The officers of the Edison Illuminating Company, of New York, the Edison Electric Light Company, of Great Britain and Europe, and the Edison Electric Railway, will also be in the building. Vice-President Eaton said recently that Edison's invention was complete and they were at work getting rights in various cities to put the wires in the streets and to light the street lamps; they had received three or four thousand applications to light houses and hotels. The company, however, would contract to light cities only.

Mr. John Wiley & Sons, 15 Astor Place, N. Y., have in press and will shortly issue a work on Calculus of Variations, by Louis B. Carll, graduate of Columbia College. In addition to the unusual interest attaching to a work of this character, from the high order of mathematics investigated, popular interest will be awakened when it is known that the author has been blind from his birth. The subject is one rarely treated by mathematicians, and so far as is known, but two works have ever been written in English. Mr. Carll's book has been carefully examined by high mathematical authorities and pronounced thorough and exhaustive. The memory required to dictate such a work, encumbered by intricate and very difficult formulæ, is most surprising, almost passing belief, yet the author has given to the public an octavo book of some 250 pages, and the manuscript has been pronounced almost free from error. It is the intention of the publishers to make this book as to typographical work fully as good as the Calculus of Profs. Rice and Johnson, which is stating that it will be equal to the finest specimen of mathematical type in the English language. The sale for such a book being limited, it will be issued as a subscription volume at $4, and may be expected about June or July. By some strange error *Harper's Weekly*, which noticed the book, attributed it to another publisher, but the work is being published by the firm above named, to whom all orders should be addressed.

Mr. Charles A. Sweet, of Syracuse, brother of ex-State Engineer and Surveyor, Sylvanus H. Sweet, has been appointed Chief Engineer of the Mexican Central Railway, with orders to proceed at once to Mexico and make a reconnaissance of the country "from a suitable point somewhere on the Rio Grande between Eagle Pass and Laredo, and proceeding by the general route indicated to the proposed main line of the Mexican Central, striking that line as far north as possible near Durango." Mr. Sweet left this city for Mexico, by the land route, on the evening of the 26th ult., and his reports will be made to General Manager Rudolph Fink, City of Mexico. Mr. Sweet's extensive and varied experience eminently qualifies him for success in this grand enterprise. His services, for several years, upon the public works of New York State as assistant and division engineer, are highly commended at the State Department. He served on the Vera Cruz & Mexico Railway in 1865-66, under General Talcott, and when that corps was relieved he was retained, at double salary, by Mr. Lloyd, the English contractor, and located the most difficult part of the lines through the mountains of Orizaba. In 1868-64 Mr. Sweet had charge of surveys for an inter-oceanic ship canal, which resulted in fixing upon what is known as the "San Blas route." In 1871-72 he was employed by Henry Meiggs, in Peru, and successfully located the great summit or Oroya road, from Lima to the summit of the Andes, overcoming an elevation of 16,000 feet by steep grades, sharp curves and switch backs, in 130 miles. In 1878 he was invited by the minister of public works to Brazil to take charge of their improvements, but was informed, in an interview with Dom Pedro, that the administration had changed and suspended all public improvements, which necessitated his return.

HALL VERSUS OSGOOD—DREDGING MACHINES.

To the Public:

In the late number of ENGINEERING NEWS there appeared a card signed by R. R. Osgood, in which he asserts that my dredge, illustrated in the NEWS of Dec. 18, 1880, is an infringement on his patents of 1873, 1875 and 1877. He also says, "See and compare my articles in ENGINEERING NEWS, of May 10, 1879, and in *American Machinist*, of July 3, 1880," with the cut of my dredge. To facilitate this comparison I insert the illustration again in this number, whereby the public may see the difference in construction at a glance.

I employ only the dipper and dipper-handle in common with Mr. Osgood, and these are not his property. My dredge is an ordinary clam-shell or grapple machine, with the derrick and boom placed upon the extreme forward end of the scow so that the dipper may be made to reach well back and thereby get the required sweep upon the bottom. The dipper plays in a slat in the boom, and is operated by two chains that are also employed to handle the grapple or clam-shell. I employ the old style of rack and pinion to hold the dipper down upon the bottom, as a great many firms have pronounced this superior to the clamp invented and used by Osgood for the same purpose, as the dipper can be lowered more carefully and thus avoid battering its cutting edge out of shape.

I can assure the public that none of the parts of the dipper-dredge, as constructed by me, are covered by any patent now in existence; and as Mr. Osgood has never seen any drawing or specification of my dredge, which he could compare with his patents, it is evident that the insertion of his notice was only an attempt to frighten the public and injure my business. I am prepared to build my dredge for any one who may want it, and will stand responsible to all who may wish to purchase and use it.

The superiority of my dredge will be readily seen when it is to be employed for deepening canals and channels where the dredged material is required to be placed upon either bank, as an extra long boom may be employed and the material deposited well back from the margin. And where the dredged material is to be deposited on scows, the latter can be placed on each side of the dredging-boat, as the dipper can be swung to either side at will. This is an important advantage, as an empty scow can thus be placed in position while another is being loaded, and thus the time employed in changing the scows be economized. Another advantage is that any kind of material may be dredged.

When dredging soft material I do not think it will be necessary to substitute the clam-shell for the dipper. Both being operated by the same chains, one can be handled about as quickly as the other. These same chains are also employed to swing the boom from side to side, which is a very much quicker and simpler mode of doing it than by means of the complex arrangements of turn-tables, gears, independent engines, etc., shown by Osgood. I claim that there is less machinery employed in manipulating my dredge than in any other dipper-dredge known; in fact I employ no more machinery than is employed on the ordinary clam-shell dredge, which is well known to be the simplest dredging machine in use.

I give below a carefully prepared opinion of a well-known firm of patent solicitors and experts on the question at issue, to which I call your attention:

OFFICE OF BURKE, FRASER & CONNETT,
PATENT SOLICITORS,
37 Park Row, New York, Feb. 23, 1881.

Captain A. E. Hall, Plainfield, N. J.:

SIR: At your request we have carefully examined your dredging apparatus, illustrated in ENGINEERING NEWS of Dec. 18, 1880, and the detail drawings of same you have submitted to us, with the view of ascertaining if any of the features of said apparatus infringe upon any patents granted to Ralph R. Osgood during the year 1873, 1875, and 1877.

We find that the following patents were granted to said Osgood during those years:

R. R. Osgood—Mode of fastening racks on handles of Dredging-Dippers, Sept. 30, 1873; No. 143,247.

R. R. Osgood and F. Brotherhood—Dredging Machine, May 4, 1875; No. 162,763.

R. R. Osgood—Dredging Machine, May 4, 1875; No. 162,849.

R. R. Osgood—Dredging Machine, July 13, 1875, No. 165,608.

R. R. Osgood—Dredging Machine, Oct. 27, 1877, No. 196,378.

The patent No. 143,247 is for a mode of securing a rack to a dipper-handle. This mode you do not employ, and you do not infringe on this patent.

The patent No. 162,763 is for a special construction of hollow suspended trunions for the hoisting-chains to pass through, said trunions forming pivotal axes for the boom, which is also of peculiar construction. We do not find in your apparatus any of the features claimed in this patent, and you do not infringe on the same.

The patent No. 162,849 is for a peculiar friction-clamp to control the dipper-handle, said clamp being arranged to oscillate on trunions which have bearings on the boom. You do not employ a clamp for the dipper-handle embodying any of the features herein claimed, and you do not infringe on this patent.

The patent No. 165,608, is for a mode of swinging and operating the handle of a dredging-dipper, in connection with a boom capable of angular motion both horizontally and vertically. In the former patents of Osgood the boom is arranged at a fixed vertical angle, but adapted to swing horizontally on a vertical axis. In the patent No. 165,608, he shows a boom and dipper of a similar construction, except that the boom is also provided with tackle for hoisting it or lowering it while dredging, so as to set the dipper at a greater or less depth without the necessity of sliding the dipper-handle through a clamp. He thus dispenses with, or may dispense with, the clamp.

Your boom is not arranged to be adjusted vertically. Its angle is fixed once for all, and the dipper-handle is arranged to play longitudinally by means of a rack and pinion, or other known device. Therefore you do not infringe upon this patent of Osgood.

The patent No. 196,378, is for an arrangement of horizontal guide-sheaves on a turn-table, and for the peculiar construction of the turn-table. You employ no turn-table and no sheaves arranged in this manner, and consequently do not infringe on this patent.

In conclusion, therefore, after a careful examination of the said patent, and with a full knowledge of your dredging apparatus, we are of the opinion that nothing in your apparatus, either in whole or in part, infringes on said patent of Osgood. Very respectfully,

BURKE, FRASER & CONNETT.
Patent Solicitors and Experts.

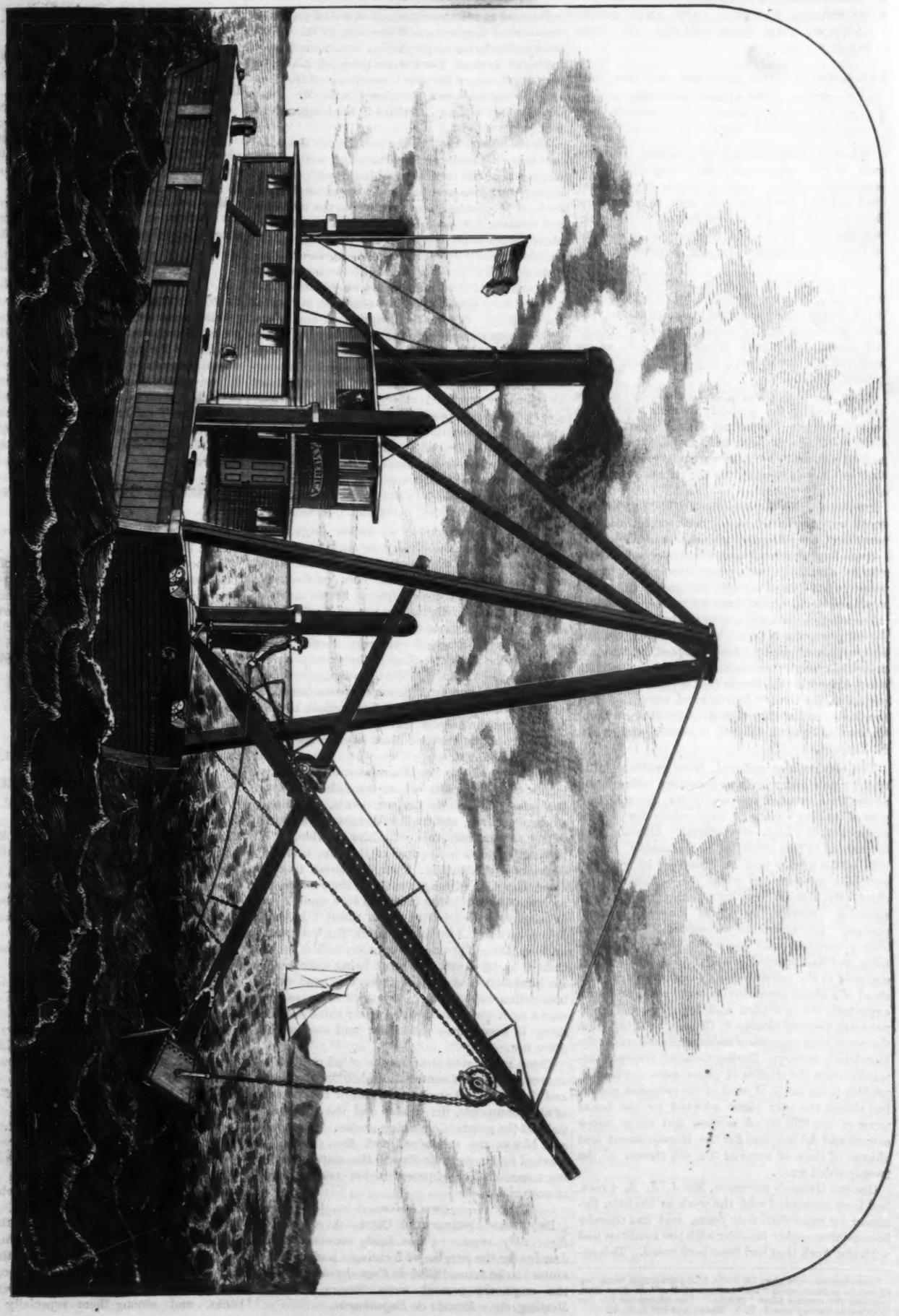
With this I leave the public to judge for themselves between Osgood and myself.

A. E. HALL, Plainfield, N. J.

MARCH 1, 1881.

A NEW MOTOR.

An exhibition was given Jan. 31, in Jersey City, of a new fuel combination of petroleum and steam, and the exhibition was of such a satisfactory nature that results are promised of importance not easily exaggerated. Col. Rose, of the Pennsylvania railroad, says a locomotive can be run from New York to Philadelphia for four dollars, instead of twenty-five dollars as now with coal. The *Commercial* says: "To produce the combination nothing more is necessary than, by means of an atomizer, to unite dry steam and crude petroleum, only a common inch pipe being necessary for this purpose, one for the steam and the other for the oil, with cocks to regulate the flow. A junction is made within six inches of a perforated brick retort, which a nozzle enters. Instantly on the match being applied the whole interior of the furnace (an ordinary reverberatory smelting furnace) becomes intensely heated, so much so that all exposed surfaces may be easily fused. If applied to a steam boiler or locomotive, or on shipboard, it is only necessary to place the retorts made by fire clay on the grate bars, thus protecting the boiler slats from injury."



HALL'S DREDGING MACHINE.

SURVEYING, LAYING OUT AND MONUMENTING THE NEW WARDS OF NEW YORK.*

BY S. S. HAIGHT, CIVIL ENGINEER AND CITY SURVEYOR, WEST FARMS, NEW YORK.

III.

While the surveys were in progress, draughtsmen of the department were engaged in the preparation of large maps to a scale of one hundred and fifty feet to an inch, upon which contour lines were placed at every ten feet difference of elevation as indicated on the contractors' sheets and on the sheets prepared by the department engineers.

These maps were on wide mounted paper, in large rolls, and gave facilities for the studies of the drainage requirements of extended areas, and of an intelligent subdivision of the land by avenues and streets of easy grade, so placed as to be of the most value to the property adjoining, and to the general public.

Many of the existing streets were found to have been located by the property owners solely with reference to the convenience of each for the subdivision of his own land, and, as may be readily understood, many of these were wholly unsuitable, both in line and grade, for the streets of a great city.

In planning for the new streets the main lines of travel were made the bases, and where contours permitted, a rectangular system was used.

Some large land owners were opposed to any system that did not place streets along their property lines, even though the grades of streets so placed would be too steep for travel.

For a long time a tie vote in the board prevented the adoption of any plans, but Mr. Grant had the satisfaction of seeing them adopted and monumented for the streets and avenues of the twelfth ward, known as the North End division, and for a portion of the twenty-fourth ward, along the Harlem River, and at the crossings of the Hudson River Railroad at Spuyten Duyvil, Riverdale, and at Mt. St. Vincent.

The service also suffered from political influences, a new and wholly unnecessary office being at one time created apparently for the sole purpose of making a place at large salary for a near connection of a high city official. Although the incumbent of this office did not probably earn a tithe of the money that he received, he yet had sufficient influence to cause the removal of his chief (Mr. Grant was transferred to the construction bureau as Chief Engineer, which position he afterward resigned), who had been connected with the work from the beginning, and had previously been the superintending engineer in the construction of Central Park. Instead of a direct promotion (as was without doubt expected), the new civil and topographical engineer was General George S. Greene, who had been the consulting engineerof the commissioners for the Morrisania Survey. During General Greene's administration the studies of plans were continued, profiles being made of most of the proposed routes, but almost the only plans adopted by the board were of the Mill Brook sewage and some minor sewers and drains, and for the improvement and change of lines of some of the old streets of the twenty-third ward.

General Greene's successor, Mr. J. J. R. Croes, had been connected with the work as Division Engineer for more than four years, and had thereby become thoroughly familiar with the localities and with the work that had been performed. This appointment gave encouragement in well doing to all members of the force, as it was felt to be in the nature of reform, a promotion consequent upon approved service. For the designing of plans for the new streets of the wards northeast of the Harlem River, the board associated with Mr. Croes Mr. Frederick Law Olmstead, landscape architect.

This was done because the members of the board had become convinced that the rough nature of a large part of the territory required a park form of laying out; the avenues and streets curving in such a way as to conform nearly to the contours, and needing for its most successful accomplishment the æsthetic study of the landscape architect as well as the skill of the civil engineer.

As a result of this action and of the harmonious composition of the board, plans were devised *and adopted* for a large part of the roughest portion of the territory. Before the adoption of any plans, opportunity was given to the land owners to examine them and express their approval or disapproval, but those adopted met the general concurrence of the parties affected. The first large tract so planned was termed the "Riverdale District," and included the promontory of Spuyten Duyvil and the east shore of the Hudson from Yonkers City to Spuyten Duyvil Creek.

For the purpose of monumenting this tract, traverses were carefully measured in such a way that a station should be within reasonable distance of every street, tangent, point and intersection.

These lines were made to inclose large areas, which were then subdivided in such manner as the plan required, the whole being connected by angle and distance with the base or northerly production of the true east line of Tenth Avenue.

The next step in the work was the calculation and balancing of these traverses, the co-ordinates (or latitude and longitude) of every station being established. The center line of the planned streets were also calculated, and the co-ordinates of every tangent point, and intersection was established.

The monuments were set at these points, the distances from the nearest traverse stations and the angles from the traverse lines having been previously calculated.

For many of the broad avenues, or park ways, monuments were also set on the radial lines, on the street side of the tangent points, or points of change of curve, and ten feet distant therefrom.

The monuments are of white marble, 3 ft. in length and 6 in. square at the top, smoothly dressed for at least 6 in. down, and so set that not more than 4 in. of length is above the surface, the monument point being indicated by a small cylindrical hole drilled in the stone about 1 in. deep. When on rock, iron bolts, 1 in. in diameter, and 9 in. long, are set by sulphur in holes, drilled not less than 6 in. in depth, the point being indicated by the intersection of a cross-cut on the head of the bolt with a cold-chisel. Four sets of maps were made on a scale of 80 ft. to 1 in.; three sets for filing in accordance with law, and one set for office use.

These maps give the lengths of all radii, of all arcs or tangents of center and side lines of streets, and the size of all angles; they show the position of all monuments, the grades and the street altitudes at the points of changing grades. The streets and blocks are numbered and the streets are marked to denote their classes, the statute decreeing a special mode of procedure for opening streets of each class.

*CORRECTION.—On page 74, *ante*, fifth paragraph from top of middle column, read "for" instead of "or" in first line, omitting the comma after "points." The contractor for the Morrisania Survey was S. D. V. Mason and not Z. D. V.

BRAZILIAN ENGINEERING CLUB.—A meeting of some fifty engineers was lately convened in Rio Janeiro for the purpose of forming a society of engineers to be termed *Club de Engenharia*. Among the engineers present were Messrs. Mackey, Morsing, etc.—*Revista de Engenharia.*

CORRESPONDENCE.

PROBLEM IN R. R. CURVES.

CAMP CLEAR CREEK, Col., Feb. 23, 1881.

EDITOR ENGINEERING NEWS:

Inclosed I send a problem in railroad curves, which please give a place in your columns:

Two tangents, A C and C B, intersect at an angle of 60°. It is required to begin at the point A and locate 2,000 ft. of 2° curve, followed by 2,000 ft. of 1° curve.

Required the distance to be measured back from the intersection C to the point of curve A, by the shortest and simplest method. L. E. VEL.

FORM OF STREET R. R. RAILS.

SAVANNAH, Ga., Feb. 24, 1881.

EDITOR ENGINEERING NEWS:

Will some of your correspondents who are posted in such matters reply to the following:

What is the most approved form of rail for street railroads? 1. When street is paved. 2. When street is planked. 3. When street is neither paved nor planked. What are the objections urged against the T rail, and would not these objections disappear if the T rail was laid on a stringer, the top of the rail being on a level with the grade of the street? SUBSCRIBER.

RENSSELAER POLYTECHNIC INSTITUTE—CORRECTION.

PHILADELPHIA, March 2, 1881.

EDITOR ENGINEERING NEWS:

The account of the recent meeting of alumni of the Rensselaer Polytechnic Institute, published in your paper of the 26th ult., while generally correct contains two errors affecting myself, which I think you will agree with me need correction, and to which I would ask your attention. In my remarks I stated that previous to the year 1824 there were but few engineers in this country; your print gives 1834. I also mentioned that I commenced my professional career at the early age of 17 years, not 22 as stated in the report.

Very respectfully,

W. H. WILSON.

SHUNK'S FIELD ENGINEER.

CHAMPAIGN, Ill., Feb. 28.

EDITOR ENGINEERING NEWS:

I have had occasion to look over Mr. Shunk's "Field Engineer" somewhat carefully, and the following errors have appeared, in addition to those which you have already published:

Page 34, 9th line from top, 153 should be 15.3

Page 45, 21st line from top, *seventeen* should be twenty-six (for 1880).

Page 102, 9th line from bottom, $R \cos. a - r + (R - r)$, should be $(R \cos. a - r) + (R - r)$.

Page 118, 1st line $(R - r)$ should be $(R + r)$.

Page 121, 9th line from bottom $(K + I)$ should be $(k + I)$.

Page 126, 11th line from top $(R + r) \cos. B + D + (R + r)$, should be $[(R + r) \cos. B + D] + (R + r)$.

Page 127, 5th line from bottom, $90° = (\frac{1}{2} A + a)$, should be $90° - (\frac{1}{2} A + a)$.

Page 130, 11th line from top, $\sin. \frac{1}{2} (F - S)$, should be $\sin. \frac{1}{2} (F + S)$.

Yours, CHAS. H. NICOLET.

ADDITIONAL WIDTH OF GAUGE ON RAILWAY CURVES.

PROVIDENCE, R. I., Feb 28, 1881.

EDITOR ENGINEERING NEWS:

The article about "Additional Width of Gauge on Railway Curves," which appeared in ENGINEERING NEWS, FEB. 19, brought me to think that I might be able to give some information, as I have had opportunity to study several German textbooks, and among them especially Baron von

Weber's. I have also had some experience in widening the gauge on curves on railroads in Sweden and Norway, where it is always used and considered very important.

In all the German text and hand-books in civil engineering I have seen there are rules and formulæ for widening the gauge on railroad curves.

The rule says: In railroad curves with radius less than 1,000 meters the inner rail shall be moved in toward center from 10 to 30 millimeters, according to the radius.

Another rule is that there always ought to be free play room of at least 100 millimeters between rail and wheel flange.

Not having any text-book at hand, I am not able to give any formula except one I remember, which does not give any general idea about it:

R = radius of curve in meters, and W = widening of gauge in millimeters. $W = 0.3\ (1{,}000 - R)$ *millimeters*. 0.3 is a constant found by practice. This formula gives about the same result as the table in Mr. Doane's paper.

I have always been under the impression that the widening of the gauge on curves has not been considered necessary in this country, because of the small distance between the rigidly connected axles of the truck.

In Europe, where the cars are resting on two axles rigidly connected with a distance of 12 to 15 feet, it is more important to widen the gauge in curves with small radius.

That the distance between axles is a great factor here is easily seen, when remembered, that in curves the wheel will not go parallel to the tangent of the joint where it touches the rail, but parallel to the tangent of centerpoint between the outer wheels.

Now, the longer the distance between axles and the shorter the radius of the curve the greater will the angle be between rail and flange, and the car get an oblique position. In widening the gauge sufficiently the car will be allowed to pass through the curve in this oblique position without any undue side pressure on the rails. The widening, therefore, ought to be so great that the flange will not be allowed to press against the rail.

JÖRGEN DAHL.

ARTIFICIAL BALLAST FOR RAILWAYS.

BOSTON, March 2, 1881.

EDITOR ENGINEERING NEWS:

In your issue of Oct. 16, 1880, you published an extract from the Chicago *Times*, headed "The Pavement Problem Solved," in which a new process is described of making road surfaces with burnt clay, and also alludes to the application of the new material in the construction of the boulevard between Douglass avenue and Central Park, Chicago, by the patentee, Mr. Wm. Davy, who was then introducing the new system into the United States from England, where it had been proved for twenty years, under iron feet and iron wheels, without symptoms of destruction, and that it combines all the desirable requisites of smoothness, cleanliness, noiselessness and practical imperishability, yet costing but a fraction of any other popular system; the article further states that as a railroad ballast Mr. Davy's process will become a national necessity.

At the time of reading the above I was engaged in the construction of a railroad in Missouri and Iowa, where there was no material suitable for ballasting the roadbed, and thought this would prove a very valuable suggestion. I therefore read the article to Mr. J. H. Hayward, Road-Master of the K. C., St. Jo. & Council Bluffs R. R., an Englishman of long experience on English railways. He then informed me that the experiments with this material for ballast had been very thoroughly tried upon thirty miles of the Midland Railway; also on the Oxford, Worcester & Wolverhampton Railway for about fifteen years, from 1838 to 1853, and in both instances had been abandoned, as it was found that the tamping necessary to keep the track in order resulted in pulverising the burnt clay, reducing it to its original fineness of grain, so that in wet weather it acted like clay, retaining the water and having other defects common to clay roadbeds; it was found, after long continued trials, that it was not practicable to burn it so hard as to prevent its being pulverized; it was therefore abandoned on the above named railways, and on some others where the experiment was tried. Mr. Hayward worked as an assistant to his father, who was road-master of one of the above named roads, and had practical handling of this material for several years, which he states was clay burnt precisely as described in Mr. Davy's process. And Mr. Hayward is a man whose statements can be relied upon.

At the time I meant to have written you on the subject, but neglected to do so. I am now, however, again reminded to tell you of Mr. Hayward's experience by an article headed "Artificial Ballast," page 805, in *Scribner's Monthly* for March, referring to the same material as having been introduced as ballast for railroads, and which promises to be of value in districts where gravel and natural road material are not available.

Yours truly, D. W. CUNNINGHAM.

FIELD BOOKS AND LOGARITHMS.

EDITOR ENGINEERING NEWS:

In your recent notices of "Recent Field Books" you point out the advantages of the "pocket-book form" for engineers, and also the practical superiority, in many cases, of simple approximate solutions and formulæ over those, perhaps more accurate, but more complex and intricate. I would like to say a few words having, I hope, a direct bearing upon these questions.

All supposed accurate solutions are far from yielding accurate results. The result cannot be more reliable than the data upon which it rests, and the data of the field engineer is often inaccurate; indeed, never perfect. The attempt with fine-spun theories and processes to improve upon the data, and to bring light out of darkness, is truly irrational and nonsensical. Surely no amount of mathematics can make up for deficiences in the "plain essentials" of the case.

It is well to remember that the simpler the explanations and the formulæ, the less the probability of error. Lengthy and entangled formulæ naturally conduce to error; and when they must be blindly followed, as is often the case, the tendency to error is much increased.

But appearances are sometimes deceptive, even in mathematics. Certain approximate solutions and results are nearer the truth than others supposed to be accurate. Some simple, approximate trigonometric formulæ yield results more accurate than can be obtained with the accurate formulæ if logarithms (even seven-place) are used in connection with them. We seem frequently to forget that logarithmic tables often involve errors greater than those contained in many approximate formulæ.

And now, Mr. Editor, if "Engineers' Field Books" should include the useful only, and why should they not? I am led to question the propriety of encumbering their pages with tables of logarithms. Even if such tables were time-saving or conducive to accuracy *occasionally*, they could well be spared from books that must be carried by the engineer at all times and places. But they serve no such purposes. I make the plain assertion, with no fear of successful contradiction, that the use of logarithms in field computation, is time-consuming, conducive to error, and that they serve as a delusion and a snare. And I might make my statement much more comprehensive; but I am now speaking of field operations.

The different members of a class in trigonometry, though using identical tables every day, scarcely ever agree in their results. What is the probability that those who use them only occasionally will use them with more accuracy or facility. All computations required by the field engineer are much more easily and quickly made without than with logarithms, even when no special aids are at hand.

If, however, advantage is taken of *useful* tables the difference is greater still. Indeed, the real worth, or rather worthlessness, of logarithms, in almost all actual cases met with in practice, is best shown by comparison with the best aids otherwise obtainable—tables of natural numbers.

In the higher branches of mathematics, the answer to some question or problem is frequently found to be a logarithm of some quantity, which becomes, therefore, the *end* sought.

In a possible case or two, they may be used as a means to the desired end. These cases are, however, barely possible in practice and never occur in field operations.

Logarithmic tables swell the volume and cost of field books, and so the book-makers gladly insert them for the practical (?) engineers to carry about.

Things are valued often for their age—because they have come down from the misty past. And this accounts, I think, for the popular view of logarithms.

I have no kind of sympathy with "rule of thumb" methods, with loose work of every description, or with careless engineering in any of its forms or phases. And I have as little sympathy with pretenses to accuracy through computations to the fourth decimal place, though the data is only approximate; or with the using of elaborate logarithmic tables, while the time thus squandered might be employed in giving a wider knowledge of the principles of engineering, or in some other useful way.

P. H. PHILBRICK.

IOWA CITY, Ia., March 1, 1881.

POLYTECHNIC INSTITUTES.

TOWNE SCIENTIFIC SCHOOL,
PHILADELPHIA, March 1, 1881.

EDITOR ENGINEERING NEWS:

Permit me to make a few remarks concerning the article on the Rensselaer Polytechnic Institute published in ENGINEERING NEWS of Feb. 26. It appears that there yet remains considerable ambiguity as to what constitutes a course of *civil* engineering, for the opening sentence states that this school "is, we believe, the only exclusively civil engineering one in this country," and further on occurs the statement that "its course of study although arranged for students in civil engineering, yet is believed to be well adapted, etc., * * to the careful study of the mathematical, physical and natural sciences, * * to secure to all graduates a professional preparation * * for the following specialties," * * among which are found: * * "the construction and *management* of mills, *iron* works, *steel* works, *chemical* works and *pneumatic* works; * * the survey and superintendence of *mines*; the design, construction and use of *wind* motors, *hydraulic* motors, *air engines*, and various kinds of *steam* engines; * * of machines in general; surveys of rivers, lakes and harbors; determination of latitude, longitude, time and meridian; projections of maps, etc., etc." It would appear from the above, then, that the civil engineer from Troy must be an iron master; a metallurgist; a chemist, an hydraulic, mining, pneumatic and mechanical engineer; a surveyor, geologist, draughtsman and topographical engineer, and that he *must* be *all* of these, as there is, according to the article, no election of

studies. Stress is laid upon the fact that although "there is a department of engineering attached to numerous American colleges, * * we can hardly expect to find these so well equipped in every branch of the profession as they would be if they were surrounded for the four years course only by an atmosphere completely, rather than partially, surcharged with the influences of an exclusive system of instruction such as would naturally prevail at the Troy school."

This extract gives rise to several queries. Does the extensive course of study already enumerated constitute exclusively one of civil engineering? If not, is not the *Polytechnic*, only nominally, the "only exclusively civil engineering school in this country?" But it is not even that, for the Thayer School of civil engineering is essentially such, and the requirements for admission are such as to enable only graduates of other colleges to enter it.

Again, can a student compelled to take so extensive a menu digest it all in four years and live? In short, can he be a proficient "jack of all trades"?

Are not the courses of many of the later engineering schools quite as complete as that at Troy, and yet so arranged that the student may elect some one or more special subjects, concentrating his attention upon them and such auxiliaries as he may find time for? And in general would not such a system be more efficient, especially if the time be extended to five years instead of four?

Are there no other schools "so well equipped in every branch of the profession?" Indeed as to apparatus, I found the *Polytechnic*, as compared with the Massachusetts Institute of Technology, Columbia School of Mines, Stevens Institute of Technology, or Towne Scientific schools, with which I am familiar, particularly deficient, and it is one of the features of modern methods of instruction to which her alumni might give some attention with benefit to their alma mater.

Is the Institute, true to her name and charter, *polytechnic?* If so, can she be *exclusively* a school of civil engineering?

Understand me, I do not wish to say one word derogatory to the exalted reputation of this pioneer polytechnic school; pre-eminent among American technical institutions, her glory is shared by all similar schools, and her sons have helped to make them what they are; to the wisdom of her founder is due the wonderful constructive development which has so rapidly increased the wealth and resources of our country and in which her sons are participants.

What I claim is that the curriculum and equipments of the Rensselaer Institute are not superior to those of many of the scientific schools of more recent birth, but that through the twenty or more years of single blessedness which she enjoyed, she was the only source from which men of any scientific attainments could be drawn. This is her vantage ground, and her prestige is based upon it. Her graduates are older, have had time to accumulate a ripe experience, are more numerous, and hence better known than those of any later scientific schools; her childrens' children return to the maternal bosom for wisdom, and give while they take, thus mutually supporting each other. Her graduates are abundantly able to provide for her, and I believe will do so freely and fully. At the same time is it not well, in the interests of scientific education in general to ask your readers to remember that Troy is not *the only* civil engineering school in the country where earnest efforts are made to prepare young men as fully as may be done by any theoretical course for the active duties of one of the most useful of professions. I do not find a single subject in the Rensselaer catalogue which is not taught in our own school excepting botany, of which we take only such parts as are required for a knowledge of paleontology and some forestry.

L. M. H.,
A Professor of Civil Engineering.

AMERICAN PORTLAND CEMENT.*

The value of concrete depends so much upon the bond which exists between the ingredients, that the cement which performed this office should be described.

It was believed that the ordinary light-weight cements would not be suitable for work exposed immediately to the action of salt water and the violence of the waves.

The following specifications were therefore determined upon:

First. That the cement must resist without fracture a tensile strain of two hundred and fifty pounds per square inch seven days after the specimen briquettes of two and one-quarter inches sectional area were made, during six days of which they must be immersed in water.

Second. That at least eighty per cent. of the cement must pass through a sieve of two thousand five hundred meshes to the square inch, and

Third. That the weight of a struck bushel must be at least one hundred and ten pounds.

Careful inquiries and examinations were made to find a cement that would not only conform to these specifications but would be recommended by those who had used it under similar circumstances.

The tests made by Mr. W. W. Maclay, of the Department of Docks of New York, showed that Saylor's American Portland cement was fully equal to these requirements, and ranked with imported Portland cements.

As large quantities had been used by that department and had given satisfaction, a contract for delivering seven thousand barrels was made with the general agents, Messrs. Johnson & Wilson, 93 Liberty street, New York.

As this cement has performed an important part in the construction of the concrete, a description of its manufacture will be given. The material and works are in Pennsylvania.

It is manufactured by what is termed in Europe the dry process. The stone, as it comes from the quarry near by, is ground in steam crushers and mills to an impalpable powder.

It is then thoroughly mixed in an iron mixer on its way to the pug mills, where it is tempered with water.

The product is then treated in a manner similar to the English method of making Portland cement, namely; it is spread out upon drying floors, and, when stiff, is cut up into blocks the size of bricks; these, when dry, are placed in the kilns with alternate layers of coke, and burned.

The clinker is then carefully selected, the pulverulent scorified, and the underburnt taken out; it is then ground and conveyed to the storerooms, the area of which is nineteen thousand square feet, where it is left a few weeks to sweat.

It remains in bulk in store until needed, and is then packed in barrels well lined with paper, to protect it from dampness—a provision especially needed in the damp climate found at the mouth of the Mississippi River. This cement, as shown by chemical analysis, is composed of the following ingredients: silica, 22.04; alumina, 10.11; sesquioxide of iron, 1.61; sulphate of lime, 1.78; lime, 61.93; magnesia, 2.13; total, 99.60. Eleven kilns are used for the manufacture of Portland cement, with a capacity of five thousand barrels per month.

The ordinary natural cements differ from Portland cement in the following particulars.

They are simply the quarried cement rock, ground once only, in which are wanting several of the ingredients enumerated above, viz., silica, alumina, etc. (The tensile strength of cements given following, is from tests made seven days after mixing, if not otherwise specified).

Natural light-weight cements, gauged neat, give about seventy pounds per square inch tensile strength, and weigh about seventy-five pounds per struck bushel.

Careful tests applied to about one-tenth of the twelve thousand two hundred and seventy-five barrels of Saylor's Portland cement, received at Port Eads, give the following results: Percentage of fineness, eighty eight; average weight of struck bushel, one hundred and twenty-two; average tensile strength (one part cement, two parts sand), one hundred and two pounds per square inch; maximum one hundred and thirty-three and one-half pounds; average tensile strain, neat cement, two hundred and sixty-two and one-quarter pounds per square inch, and the average of the maximum breaking strains of each lot of about ten briquettes, three hundred and twenty-five and one-quarter pounds per square inch.

Since, on account of the difficulty of manipulation, it was almost impossible to obtain perfect parallelism between the line of strain and the larger axis of the briquettes, this latter test may possibly reveal the actual strength of the cement more nearly than the average of the breaking strain of the whole number in each lot.

All the briquettes were two and one-quarter inches in sectional area, and were molded to fit the clamps of a Riehle testing machine. The cement, either in briquettes or in work, increases in strength and hardness with age.

Tests made by Mr. Maclay show a tensile strength of five hundred and ninety-nine pounds per square inch with briquettes ten months old, and at the manufactory, the cement gauged neat, withstood a tensile strain of eight hundred and sixty-six pounds without fracture, with briquettes nineteen and one-half months old.

The quality of the cement was remarkably uniform.

In the actual construction of the blocks, and in the severe tests given the concrete in sixteen months of exposure to the waves, the cement has proved itself to be first-class in every respect.

It has so hardened and solidified the blocks that even the edges and corners exposed to the sea are as clean-cut to-day as when, two weeks after construction, the plank molds were removed and the waves commenced to dash against them.

* Extract from "A History of the Jetties at the Mouth of the Mississippi River," by E. L. Corthell, C. E., Chief Assistant and Resident Engineer during their construction. New York, 1880.

ENGINEERING, ETC., IN FOREIGN LANDS.

[Translated and prepared for ENGINEERING NEWS.]

The *Journal fuer Gasbeleuchtung* states that gas is now employed in Prussia for lighting locomotive engine fires. A special apparatus, which consists of a horizontal and several vertical pipes, is used. The latter pipes have burners. The gas is conducted through india-rubber hose. The cost is only about one-seventh of that of wood.

Herr Veitmeyer lately recommended, before the Berlin Polytechnical Society, the following method of preventing water from freezing in pipes: The pipes are inclosed in a very thin casing of sheet-iron, and warm air sent up from the furnace. An electric apparatus for closing and opening water meters has also been patented.

The *Moniteur des Chemin de Fer* says a new material for railway wagons, etc., has been experimented with during the past year with great success. By this system the narrow-gauge can be abandoned, and a great deal of the construction, such as tunnels, etc., he rendered unnecessary. At the same time a railroad can be made through a rough country at a very moderate cost. A locomotive and two wagons loaded with lumber were run over 25 meters in six seconds, with curves of 5 meters and 2½ meters of radius, with a grade of 35 milimeters per meter. A glass of water was placed on the lumber, not one drop of which fell. The engineers present were extremely well pleased with the experiment, which will likely attract the immediate notice of the French railway companies.

The works in the harbor of Tunis will cost 60 million francs. A grand canal, 24 meters in width and 8 meters in depth will be constructed from the Goulette to Tunis.

The Austrian railways are now trying a very light kind of locomotive for the secondary or omnibus service. The cylinders are exterior and horizontal and placed behind the drawing axle.

The old French "diligence"—an appellation which it never deserved—made only three miles an hour. In 1830, it increased its speed to 4½ miles, and in 1858, when railroads began to compete, it actually attained six miles and over.

The Electric Exhibition in Paris promises to be a most interesting affair. All the great "lights" of the science will be present. It will be open from Aug. 1 to Nov. 15.

The best materials for sleepers, according to the trials made on the German and Austrian railroads, are the following: oak, fir, pine and beech, and the length of their average duration was respectively as follows: 13.6 years, 7.2, 5.1 and 2 years. But when chloride of zinc or creosote was used for coating the proportion changed as follows: 19, 16, 8 to 10 and 15 to 18 years. Chloride of zinc is now the favorite preservative, creosote comes next. Some companies use a combination of both.

The Dutch Government is about to consider a proposal for the construction of a new canal between Amsterdam and Gorinchem, with the object of improving the communication between

University of MICHIGAN

the capital and the Rhine. The work will occupy four years, and cost, it is estimated, 12,000,000 guilders (£1,000,000).

DE LESSEPS' PLANS AND ESTIMATES.

LONDON, Wednesday, March 2, 1881

A dispatch from Paris to the *Times* says: "The second constitutive meeting of the Panama Canal Company will be held on Thursday. M. De Lesseps will read another report stating that there are 102,230 shareholders; that the canal will certainly be finished by 1888, and that recent borings have reduced the estimate of the quantity of earth to be liffed from 75,000,000 to 73,000,000 cubic meters. A rough estimate of the cost of the work of excavation and construction of lateral dikes amounts to 430,000,000 francs ($84,280,000); for weirs and deepening trenches for conveying fresh water to the sea, to 46,000,000 francs ($9,016,000); for waiting dock and tide-gates on the Pacific, which M. De Lesseps does not think necessary, to 36,000,000 francs ($7,056,000), bringing the total amount to 512,000,000 francs ($100,350,000) as the estimated total cost of the canal complete and open to navigation.

"Toward the month of October the contractors will begin the great cutting at Culebra, and before the end of the year the first excavators will begin to cut out the basin of the canal in the lower parts, while in the Bay of Colon a marine dredge will scoop out a channel. The enterprise will not require more than from 8,000 to 10,000 workmen in the busiest period of the work. These will be recruited from the colored population of Columbia and the West Indies."

MEXICO'S YANKEE POPULATION.

Mexico is filled with "Yankees," as all people from the United States are called. These "Yankees" embrace engineers, capitalists, tourists, speculators, "drummers" and adventurers. The last named, however, are a disgrace to our nation, as they comprise gamblers, tramps and other high personages of both sexes, who travel incognito. This country abounds in vast natural resources, but is almost entirely undeveloped. The gold and silver mines are worked on the same plan as one hundred years ago. Sugar is ground, wheat gathered and threshed, cotton spun, paper manufactured, liquors distilled and cloth and textures of all kinds woven in the most primitive style. In fact, all labor-saving machines and the latest inventions and improvements of manufacture and agriculture are just being introduced, hence the profuse abundance of the Yankee, who, with his usual foresight and enterprise, sees an immense trade to be developed with his own country.

NOTES.

THE following recipe for keeping lamp chimneys from cracking is taken from the *Diamond*, a Leipsic journal devoted to the glass interest: Place your tumblers, chimneys or vessels, which you desire to keep from cracking in a pot filled with cold water; add a little cooking salt; allow the mixture to boil well over a fire, and then cool slowly. Glass treated in this way is said not to crack even if exposed to very sudden changes of temperature. Chimneys are said to become very durable by this process, which may also be extended to crockery, stoneware, porcelain, etc. The process is simply one of annealing, and the slower the process, especially the cooling portion of it, the more effective will be the work.

THE "TELEPHONE CITY."

Lowell, Mass., may be called the "telephone city," for it is connected by telephone with over one hundred cities and towns in the States of Massachusetts, New Hampshire and Rhode Island. The longest circuit is from Springfield, Mass., by way of Worcester, Fitchburg, Lowell, Lawrence, to Exeter, N. H., over one hundred and fifty miles, which is worked successfully. The Lowell District Telephone Company owns and operates 2,500 telephones and pays the American Bell Company a monthly royalty of over $1,200. The company controls over 1,500 miles of wire and employs in all divisions about twenty-five ladies and seventy-five men and boys.

☞A San Antonio, Tex., dispatch says: "An agent of the Texas Pacific Railroad bought on the 24th 15,000 acres of land on the Rio Grande, near Fort Quitman, paying $37,000 therefor. The International grading force are sixty miles south of this city and Pierce's force is forty miles west, both moving on toward the Rio Grande rapidly. Track-laying on the International extension will be resumed next week."

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

A bill is to be introduced at Albany for the issue of $100,000 bonds for the purpose of increasing the Buffalo water supply.

Ottawa receives $12,000 from the Dominion Government this year for water supply, an advance of $3,000 over former years.

The president of the village of Tarrytown, N. Y., has been authorized to make a contract for the purchase of 3,700 feet of eight-inch pipe, together with the necessary hydrants, valves, connection pipes and all other necessary appurtenances for supplying the inhabitants with pure water for domestic purposes and the extinguishing of fires.

STREETS, DRAINAGE, ETC.

The Clayton Steam Pump and Air-Compressor Works are pressed with orders for their "Improved Air-Compressors." Recent shipments embrace duplex compressors to Canada and Australia (this probably being the first consignment of air-compressors from the United States to the latter place); a No. 7 duplex compressor, 18" diameter of cylinder × 24" stroke, for the Morris Run Coal Mining Co., of Pennsylvania, for use in running the Harrison Coal Cutting Machines; a No. 7 duplex to the Chateaugay Ore Co., Plattsburgh, N. Y.; two No. 4 duplex for use in sinking the caissons for the Bismarck Bridge on the line of the Northern Pacific Railroad, and in addition some ten air-compressors of various sizes, duplex or single.

BRIDGES.

The tender of the Toronto Bridge Company, for the erection of an iron bridge over the Thames at York street, London, Ont., has been accepted at $0,000.

Eleven spans of the bridge across the Arkansas River at Kinsley, Kan., were carried down stream Sunday by high water and floating ice. There are nine spans standing, but fears are entertained that they will be carried out.

Owing to the large amount of work they have on hand and the many contracts received for bridges to replace those swept away by the late flood, the Morse Bridge Company are running their establishment night and day. Brown, Bonnell & Co. are adding a number of steel boilers to their establishment, preferring them to any made of other material. The erection of a large building has been commenced by the Mahoning Valley Iron Company, which will contain a muck mill. The new structure will be 62 feet wide and 160 feet long, containing ten puddling furnaces and a train of large muck rolls. On account of their inability to produce a sufficient amount of muck iron the company are behind in their orders. Their leasing the Hubbard rolling-mill, which will be started up next week, will enable them to catch up with their orders. * * * Bell & Odbert, tuyere manufacturers, are enjoying a most excellent trade, supplying all the furnaces in the Mahoning and Shenango valleys and filling orders that come from a distance.—*Youngstown News.*

BRIDGE LEGISLATION.—House bill number 135, which re-enacts most of the present law concerning the letting of bridge contracts by counties, supplies some needed reforms. The changes are in allowing counties which have joint interests in a bridge to be built to vote upon the matter in proportion to the amount of interest they have. This commends itself. Under the present law a county which may have to pay ten thousand dollars of a proposed bridge has no greater voice in controlling its cost and construction than another county which may have to pay but one thousand dollars. This injustice should be done away. Another provision of this bill strikes at the great abuse commanded by the present law in compelling contractors to file their bond with their bid. Abstractly the injustice of this is apparent, but concretly it is worse and worse. It results practically in contractors being blackmailed by county attorneys and agents for fees to procure bondsmen for them. An eastern bridge company, for instance, puts in a bid for a bridge in Dubois County. With it they must file a bond, and county commissioners universally hold that bondsmen shall be from that county. A Supreme Court decision has held that a boudsman can come from any part of the State, but the commissioners, always reserving the right to reject any or all bids, reject bids which have not local bondsmen. The bridge company is a stranger in the county. Hence it has to impudently ask strangers to go on its bond or pay a local agent a fee for getting a bondsman. It is a regular system of moral blackmail. The new bill provides a large cash forfeiture to furnish a bondsman if awarded the contract. Finally, this new law provides for the appointment by the Governor of a State engineer for bridges, the qualifications for which are put deservedly high, so that none but the best men in the profession can be appointed. This engineer is to prepare specifications for any county desiring a bridge, which county may employ its own superintendent and accept any plan of a bridge it wants, but the specifications of the State Engineer are to be complied with as to strength of materials and such matters. The object of this is to save counties from being swindled as they are now constantly by rascally specifications being adopted by the commissioners, mostly because commissioners are not civil engineers and are not able to know good from bad. Upon such specifications structures are built that are not what they seem; "extras" are run up and in one way or another the county is at the mercy of rascally men and is "chiseled" out of thousands of dollars on each job. A State engineer for bridges would end all this. It is a much-needed office, and the objection to "another office" does not lie here, for the bill proposes no salary for the office, but only, in case the county builds the bridge, it is to pay one dollar per lineal foot of the superstructure as a fee for the engineer's work, and one dollar per cubic yard for the masonry, which latter charge shall never exceed $100. Here, in a hundred-foot bridge, for instance, the county would pay $200 for the certainty of having a sound structure and honest workmanship, and save, as any one knows who is familiar with bridge building, thousands of dollars.—*Indianapolis News, Feb.* 14.

RAILROADS.

The new survey for the route of what is known as the Parallel road, between New York and New Haven, has been completed, and a list of the property-owners along the line is being prepared for the purpose of arranging with them for the right of way.

The Richmond (Va.) *Dispatch*, of Feb. 24, says: To-day work will be commenced on the extension of the Chesapeake & Ohio Railroad to Newport News. The whole line will be completed by the company itself, under the direction of J. S. Morrison, Chief Engineer of the eastern extension, and will be rapidly pushed forward.

A stringent order has been issued to passenger conductors, brakemen and baggage masters on the Pennsylvania railroad, prohibiting them, under penalty of suspension, from allowing passengers to ride on the platforms of passenger cars. The company is determined to break up this dangerous practice, and leaves trainmen no discretionary power in the matter.

J. Patterson, of Philadelphia, who has the contract for the construction of the Gould tunnel, eight miles west of Steubenville, Ohio, on the Pittsburgh, Cincinnati & St. Louis road, Monday sent out a large force of carpenters and other laborers, who will commence putting up buildings. The tunnel, which is to be completed by the 1st of June, 1882, will be five-eighths of a mile long and shorten the road three miles.

The Valley Railway of Ohio have just received two more new passenger locomotives from the Baldwin Locomotive Works. This Railway Company have just perfected arrangements to span the Cuyahoga River and the old ship channel, in the City of Cleveland, O., with two iron draw-bridges, and make a direct freight connection with the L. S. & M. S. R. R. The work of building the bridges will be commenced within a few days.

The scene of the most activity in railway building for the next decade is to be in the territory along the foot hills of the Rocky Mountains, and through the passes and along the cañons of the mountain itself. It will embrace the section from the Canada line to Mexico. The construction will center chiefly about the State of Colorado. In the work employment is afforded to thousands of laborers and skilled workmen. The region is now the paradise of railroad contractors and their camp followers.

The Baltimore & Ohio Railroad Company have the past week been experimenting with a new arrangement for heating passenger cars with steam. Waste steam from the engine is conveyed to a boiler or reservoir in the baggage car, from whence it is distributed to the other cars by iron pipes, a coil of which is placed under every seat. The steam enters the coils under one row of seats, and after passing through them enters the next car, and so on until the end of the train is reached, when it passes to the coils under the other row of seats, and returns to the engine.

A GREAT ENGLISH RAILROAD.—We believe we are correct in stating that, including the extra lines laid down over a large portion of its system, and the vast number of sidings, the London & Northwestern company maintains the astonishing amount of no less than 10,000 miles of railway. The capital embarked in this vast aggregate amounts to no less a sum than $500,000,000, while its average weekly receipts fall a little short $1,000,000. The company annually carries nearly 50,000,000 passengers, and between 30,000,000 and 40,000,000 tons of merchandise and minerals, in the conveyance of which its trains run 25,000,000 miles, while there are employed upward of 2,000 engines, 3,000 carriages and nearly 50,000 goods-wagons and other vehicles of various descriptions, to say nothing of a magnificent fleet of steamers, a stud of between 2,000 and 3,000 horses, and last, though not least, an army of 50,000 men.—*Liverpool Paper.*

During 1880, 690½ miles of new railroad was constructed in the State of Texas as follows: Corpus Christi, San Diego & Rio Grande—This road at the beginning of the year extended from Corpus Christi, Tex., due west 53½ miles to San Diego. In 1880 an extension toward Laredo was begun, on which track was laid 5 miles southwest, and most of the grading completed about 50 miles further to Alberca, whence the line is to extend west by north to Laredo. Gauge, 3 feet. Dallas & Wichita—Extended from the former terminus at Lewisville, Tex., northwestward 17 miles to Denton, making the road 39 miles long from Dallas northwest. It will be worked as a branch of the Texas & Pacific. Houston, East & West Texas—Extended from Trinity River, Tex., northeastward 12 miles to Livingston. Gauge, 3 feet. International & Great Northern—Extended from the former terminus at

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Austin, Tex., southwestward 52 miles to Davenport, making this line of the company 323 miles long from its junction with the Texas & Pacific at Longview southwest, and bringing it within 183 miles of San Antonio, which it will probably reach this month. Missouri, Kansas & Texas—The Denison Division (late Denison & Southwestern) was extended from Whitewright, Tex., southwestward 32 miles to Greenville, the county seat of Hunt County. East Line & Red River—Extended from Sulphur Springs, Tex., westward 30 miles to Greenville, making the line 128 miles long from Jefferson west by north. Gauge, 3 feet. East Texas—On this road the first track was laid, from the Texas & New Orleans, at Beaumont, north 6 miles to Pine Island Bayou. Galveston, Harrisburg & San Antonio—The LaGrange branch was built from the main line at Smith's Junction (3 miles east of Columbus) west by north 16 miles to Etlinger. Gulf, Colorado & Santa Fe—Extended from Sealy, Tex., northwest 110 miles to Rogers, making the road 204 miles long from Galveston northwest. Houston & Texas Central—The Texas Central road, which is an extension of this company's Waco & Norwestern division, was extended from Whitney, Tex., westward 67 miles to Mount Airy, Erath County, making the division 142 miles long from its junction with the main line at Bremond, which is 143 miles north of Houston. Texas & Pacific—Extended from its former terminus at Fort Worth, Tex., westward 151 miles making the main line 404 miles long from Texarkana. The Transcontinental division was extended from Sherman westward 17 miles to a junction with the Missouri, Kansas & Texas at Whitesboro. Texas & St. Louis—This company at the end of 1879 had two sections of road, one of 30 miles from Texarkana southwest and one of 21 miles from Big Sandy to Tyler. In 1880 it filled up the gap of 76 miles from Sulphur Fork southwest to Big Sandy, and extended the line from Tyler southwest 52 miles to the Trinity River. Gauge, 3 feet.

NEW PROJECTS.

Fifty-six miles of the east end of the Wabash & Erie Canal has been sold to the New York, Chicago & St. Louis Railroad Company for $137,000.

The Burlington & Missouri River Railroad, now a part of the Chicago, Burlington & Quincy system, advertises for 1,000 laborers and 2,000 teams to commence work early in the spring on the Republican Valley extension.

The Terre Haute & Mississippi Railway Company was incorporated at Indianapolis on the 25th inst., being simply an extension of the Terre Haute & Southeastern, with a view of reaching Sullivan. Its length is 20 miles. E. B. McClure heads the directory. Capital, $200,000.

It is asserted that within eighteen months two and a half miles of the proposed channel tunnel between England and France will have been excavated, and that the work will be completed in about four years. Still another grand scheme, however, for crossing the channel is contemplated, namely, a line of steel tubes, 16 feet in diameter, ballasted so as to make it weigh 1¼ tons to the foot more than the water displaced, and held at a depth of 35 feet below the surface, so as not to impede navigation, by chains attached to caissons sunk to the bottom.

A dispatch from Murphysboro, Ill., of Feb. 24, says: "The contract for the completion of the St. Louis Central Railroad was let to the Mound City Construction Company to-day. This company was organized about one month ago and has received subscriptions for the full amount of its capital stock. It is intended to begin the grading immediately. The steel rails are already purchased, as well as the ties. It is expected to have trains running by Sept. 1, 1881, to Pinckneyville, where they will connect for the present with the Cairo Short Line, thereby giving Murphysboro a direct standard-gauge connection with St. Louis."

The articles of association of the Terre Haute & Mississippi Railroad, with a capital stock of $200,000, divided into 4,000 shares of $50 each, were filed with the Secretary of State of Indiana, Feb. 25. E. B. McClure, Herman Hulman, Robert S. Cox, Theo. Hodnut, R. L. Thompson, Willard Kidder and G. Ehrman, are the first directors. The road is to run from Terre Haute to a point on the Wabash River, on the State line, convenient for crossing said river, thence into Sullivan County, Indiana. The length is twenty miles.

A meeting of the stockholders of the Memphis, Pine Bluff & Texas Railroad was held in Little Rock on the 25th, when the Board of Directors was increased to eleven. Messrs. W. N. Parrington, J. W. Clapp and J. R. Goodwin, of Memphis, and Messrs. W. M. Harrison and E. W. Taylor, of Jefferson, Texas, were elected additional directors and the following officers selected, viz.: R. W. Martin, President; W. M. Harrington, Vice-President; G. P. C. Rumbough, Secretary, and W. J. Thomson, Treasurer. The above road is designed to extend from Hopefield, opposite Memphis, along the west side of the Mississippi River and through Mariana in Lee County, Pine Bluff and Camden to a point on the southern boundary of Columbia County, and to be extended thence through Louisiana to Jefferson, Texas. A bill has been presented to the Legislature for a grant of lands along the line of the route for fifteen miles on either side, to take effect upon the construction of the road.

AFFAIRS IN MEXICO.—MEXICO CITY, Feb. 15.—Ninety-five more Americans have just landed at Vera Cruz, of whom seventeen form the Chicago party; and it is predicted that before the lapse of three months six thousand of our countrymen will arrive in Mexico. There are weekly arrivals of civil and mechanical engineers and people connected with the railroads, but tourists too are flocking here, and have not only filled up all the hotels and recently established boarding-houses, but are demanding lodgings in all directions. It may seem incredible, but it is an actual fact that notwithstanding the numerous books which have been written on Mexico, a large majority of the Americans who come here have the wildest ideas with regard to the mode of life, the climate, etc. Remembering only that this is an intertropical region, they forget the altitude of Mexico City, and bring clothing only suitable for Cuba. Vera Cruz or the "tierra caliente." Within a fortnight three ladies have informed your correspondent that, notwithstanding their "Saratoga trunks" full of clothes, they had literally "nothing to wear," because their dresses were principally grenadines, organdie lawns and linens. As a warning to those who may come to spend the spring or summer months here, allow me to say there is not one evening in the year in which a lady can dispense with a shawl or mantle, nor a gentleman feel comfortable without a light overcoat. Silks, merinos and cashmeres are worn here the entire year, organdies and similar materials are almost useless. The heat is never oppressive; the hottest months are not warmer than May in New York. The "rainy season" usually commences the latter part of May or 1st of June, but is not, as its name implies, disagreeable; every morning is sunny, fresh and delightful. The showers commence, generally speaking, about 3 o'clock P. M. Rain often falls during the entire evening and night, but very frequently ceases at sunset, and then people can go to the Alemeda, Zocolo or other promenades as early as 9 o'clock P. M. The only precaution necessary is, if one sits down to listen to the music (bands always play in the Plaza every fair night), to take a chair placed on the matting—these are always to be hired—and wear a light wrap. Americans who have just arrived usually laugh at the precautions adopted here to avoid currents of air or sudden changes of temperature, but many find to their sorrow that it is well to conform to the customs of the country. For example, if reading near a lamp, one should not suddenly go out in the corridors or step on to the balconies. Instances innumerable of sudden blindness have resulted from such imprudences. If one leaves a crowded church or theatre at night he must be well wrapped, breathe through the nose and not talk for a few minutes. All the old Spaniards cover their mouths with their cloaks. A disregard of these rules causes not only catarrh, but often inflammation of the lungs. Mexicans boast that there is no consumption here. True, there are but rare cases, because "pulmonia" carries off people within twenty days, and the "pulmonia fulminante" often terminates fatally in the course of a few hours. All Americans persist in sleeping with their windows wide open here as at home. After an experience of three years and plenty of famous colds and coughs my advice is, be prudent—don't throw your windows wide open. The Mexicans err even more on the other side and hermetically seal up their chambers. No amount of reasoning will convince them that this is a pernicious custom. Excuse this prosy counsel. May it prove useful to some Americans! From the different Western cities have come men who are studying Mexico, its resources and necessities, and making arrangements to increase the commercial relations between the two republics. In connection with trade between this country and the United States, the *Two Republics* (the only English paper here) published yesterday a long list of articles which are exempt from import duties at the maritime and frontier custom-houses. In his editorial Mr. Clarke says: "The articles admitted into Mexico free of duty are precisely those in the manufacture of which Americans excel—arms, wire, agricultural implements, mining tools, engines of all kinds, printing presses, pumps, railway cars, material of all kinds for railroads, machinery for agricultural, industrial and mining purposes, frame houses, corn-mills, anvils, etc. All these are manufactured in the United States. Besides, type, printing-ink, books and many other articles could be brought from the United States cheaper than from any other country. If American merchants and manufacturers do not inaugurate a large trade with this country it will not be the fault of Mexican statesmen."

The Mexican National Construction Company has secured the services of W. F. M. Ross, and a number of other Scotch and English gentlemen of Rossville, Atascosa County, for making surveys and securing right of way in Mexico. It is understood that this company is pushing things to their utmost to connect the Mexican capital with this country. It has bought out the Corpus Christi and Rio Grande Narrow Gauge, which is being built on to Loredo with all possible dispatch, and rumor says that it is contemplated to construct a branch from Janquette, Nueces County, via Goliad and Victoria, to Galveston, and a branch to Camargo. The city of Laredo has offered them the right of way across the Rio Grande, and about 150 acres of land within the city limits.

THE MARKET.

OFFICE OF ENGINEERING NEWS,
Friday Morning, March 4, 1881.

IRON RAILS: Are in good demand, and sales are reported of 3,000 tons, 40 lb. (foreign) to arrive, at $47.50; and also 1,000 tons light rails at about $49@$50. We quote at $48@$50.

STEEL RAILS.—There is abundant inquiry, but for earlier deliveries than American manufacturers can undertake, and, in consequence, a large percentage of business is drifting into the foreign market. Prices are $60@$62.

OLD RAILS.—This branch of the iron business has not yet recovered from the apathy it has so long suffered from. There are but few purchasers on the market, and offers are few and at figures that holders cannot afford to recognize. Prices are slightly lower than last week, being for Tees, $27.50@$28, and Double Heads, $28.50@$29.

AMERICAN PIG.—The transactions for the past few days have been light, no sales of any magnitude having been reported. We quote Foundry, No. 1, $25@$26; Foundry, No. 2, $22@$23; Gray Forge, $20@$21.

SCOTCH PIG.—Business is also light in this line. A sale is reported of 200 tons Summerlee at $24. We quote: Eglinton, $22@$22.50; Carnbroe, $22.50@$23; Coltness, $24.50@$24.75; Glengarnock and Gartsherrie, $23@$23.50.

The unusual activity in British and Continental iron and steel markets is attracting the attention of America. From authentic sources it is evident that not only steel rail mills, but mills engaged on ordinary merchant iron and car and bridge iron, are booking orders for future delivery. The raw and finished product in Continental mills is appreciating in value, while in Great Britain the weather has temporarily affected the value of the raw product only. The activity is due largely to activity in railroad building. In many cases furnaces and works are sold for from three to six months ahead.

MANUFACTURED IRON.—Bars are steady, with indications of an improvement. There is more demand, with the mills reluctant to make any concessions, as they have considerable orders on hand. The aspect of the market is improved, and dealers talk of better prices soon. Swedish and Norway bars command $4.15, and shapes $5.15.

Bar, ₩ lb	2¼@2¼	Steel Plates:	
Refined	2¼@2¾	Benzon	7 @ —
Tank Plate	3 @3¼	Vass	6¾@—
Shell, C. H., No. 1	3¼@3¾	Tank	6¼@—
Flange	5 @5¼		

SHEET IRON.—The situation is about the same as in our last, with the demand a little better, and continued activity at the mills.

Russia, ₩ lb	11 @11½
American, common, singles	3¼@ 3¾
American, common, doubles	4 @ —
American, refined	5 @ 5¼
Galvanized, Nos. 14 to 20	7¼@ —

Nos. 21 to 24, 8¼c.; Nos. 25 to 26, 9¼c.; No. 27, 10¼c.; No. 28, 11½c.

STEEL.—The market is active, with prices quite stiff. The outlook for a good Spring trade is very encouraging. We quote:

American Tool, ₩ lb	12 @13	Bessemer Tires	5 @ —
American Mach	3½@ 7	English Tool	14½@ —
American Bessemer	6 @ 6¼	Mushet	45 @ —

BLOOMS are dull and irregular. The best charcoal blooms are $65 per ton, of 2464 lbs. Anthracite nominal, at about $52.50.

STRUCTURAL IRON.—The demand is active and many good sized orders have been made. Bridge work is coming in quite freely, one firm alone having orders for the iron for 21 bridges. The ship yards are also busy. Notwithstanding this, manufacturers of structural iron have been able to meet all demands by running single turn, although they expect soon to double up. Quotations are as follows: 2.6c. for angles; 3.0c. for tees; 3.25c. for beams and channels.

LEAD.—It has been dull in the Lead market for many days past. Sales amounting to 300 tons in lots at $4.80@$4.82½, and 500 tons in one lot at $4.82½. Refined is 5c.

COPPER.—This line has been moderately active, sales of Lake Superior aggregating from 200,000 to 250,000 at 19¼@19⅜c.; Baltimore is held at 18¾c..

Manufactured we quote: Bottoms, 29c.; Braziers, according to size, 28@34c.; Circles, 31@34c.; Segment Sheets, 31c.; Sheathing, 26c.; Bolt Copper, 28c.